# RAILWAY ENGINEERING
and Maintenance of Way

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An article on "The Anatomy of Bridgework" set forth on other pages of this issue, illustrates we believe a peculiar difference in the discussion of engineering subjects by English and American engineers.

It is doubtful whether an American bridge engineer could write as long an article without introducing a few figures.

The American mind seems to require hard facts anl figures. A happy medium between the two would seem to be the ideal state of mind for it is true that many of the engineers in this country often are lacking in that higher analytical nature.

THE evolution of water ways into steam transportation factors is well shown in the cases of the Chesapeake and Ohio road which had its beginning as a canal, and the Delaware and Hudson Company which also had its genesis in the Delaware and Hudson Canal. The latter company was chartered in 1823 to build a canal, and followed canal haulage for a period of 75 years. The first attempt to use rails in connection with the canal was about 1828-30, when a gravity road was built near Carbondale, Pa. From that time on the development of the Delaware and Hudson, into a steam road was assured, until at the present, the road has wiped out all vestige of its parent, and the road canal no longer appears on the equipment of the road. Not so with the Chesapeake and Ohio canal, however, for that little ditch which has long ago outlived its usefulness, retains its hold on life by legislative enactment, and will probably remain forever as an object lesson of primitive transportation.

THE passing of the Chicago cable cars will not cause many tears of regret to be shed. After a few months use of the large commodious trolley car even a thought of the "grip" will pass into "innocuous desuetude." There may be a few it is true, who will be dazed and bewildered by the absence of the click and whirl of the old cable, but time will soften their trouble. Ordinances recently passed require the substitution of the overhead trolley for the cable. This means more however, than the accommodation of the public in the city streets and it may be said that the actual necessity for a change became apparent elsewhere. We refer to the lowering of the tunnels under the Chicago River, the trolley system naturally requiring less depth or practically none below the track.

Then, too, the Union Traction and the Chicago City Railway Companies will profit by the change. As every user of the cable knows, even a string of three cars does not hold an overly large crowd. Maintaining such worn out equipment with their single-truck, has as a rule seemed useless. Some day later generations will be gazing at some of these cable cars set up on exhibition probably in glass cases, and will form the deepest respect for the bravery of their ancestors for riding in such affairs.

SINCE the experience of last summer in the New York Subway during the hottest days, the experiments towards a better ventilation and cooling have been numerous. The ventilation openings and louvres already provided are said to have lowered the temperature some six or seven degrees as compared with similar weather conditions for last summer. One of the later experiments is the installation of a water cooling system at the Brooklyn Bridge Station. Two water cooling units one for each island platform will be put in as the system. Water is to be drawn from 8-inch wells with a combined capacity of 4,000 gallons of water per minute. Two of these wells have been sunk and a third will soon be completed. The water pumped from these wells will be at a temperature of from 52 to 62 degrees. Each island platform is to be supplied with a pipe cooler through which the air will be drawn by a fan at the rate of 75,000 cu. ft. per minute. From here it is to be distributed through a system of ducts to selected points in the platform, where it would be most effective. The outcome will be watchel with interest for the conditions connected with this problem are quite unusual. At first thought such a scheme as mentioned would appear quite expensive if installed for the entire length. A less expensive and more feasible plan will no doubt be reached before many weeks.

## *Mechanical Wear on Ties*

WHEN the questions referring to the practice were discussed at the last meeting of the International Railway Congress, it was revealed that there existed an opening for improvement on the methods of securing rails to the ties, this phase of the subject coming up under the head of mechanical wear on ties. The situation was seen to be a most serious one, and received the earnest attention of the Congress.

In the past, according to the proceedings of that body, the woods used for tie purposes not only gave a length of life commensurate with the original cost, because of their resistance to decay, but they also resisted mechanical wear in a satisfactory manner. In other words, the sawing action under rails, and the wearing out of wood around the spikes, necessitating respiking, did not take place with sufficient rapidity to necessitate a removal of the ties, before it was necessary to remove them as a result of decay.

The introduction of heavier equipment and increased speed of trains and also the use of inferior grades of treated timber has resulted in the more rapid deterioration of ties because of rail cutting, and the breaking of the wood fibers around the spikes long before any decay occurred. In other words, the causes for removal of many and perhaps most ties, were largely of a nature for which chemical treatment was not responsible.

It is becoming to be realized that some methods will have to be adopted whereby the softer treated timbers can be protected against mechanical wear, so that the full length of life which it is possible to obtain because of treatment may be realized. It will be necesary to conduct extensive investigations as to the use of various forms of tie plates and better methods for fastening rails to ties. This problem is a most serious one and deserving of the greatest attention and study. It is certain that unless better methods for protecting ties against mechanical abrasion and destruction by rails and spikes are devised, that the preservative treatment of inferior woods will not produce the expected results.

A consideration of these destructive elements contemplates tie plates on which the rail rests and spikes by which they are secured in contact and alignment, both of which features have little if anything in common with foreign practice, and the first of which is a variable quantity in so far as refers to standard practice, alternating between flanged and flat plates, while the spike is practically the only means used in this country for securing the rail. The destruction of the tie under the rail goes on apace, with the use of nearly all plates, the least abrasion being observed by the flat plate, but it is the growing opinion that the method of securing the rail to tie must be of a more stable character than found in the ordinary spike before relief from mechanical wear can be expected.

During the conference the practice of many foreign members gave evidence of satisfactory results in preventing abrasion under the rails. Some French and English engineers citing a life of from twenty to twenty-five years for ties which were protected from wear.

The experience of a member on the Paris, Lyons and Mediterranean was with rolled steel tie plates which were flat on the tie surface and had two lugs on the upper side which prevented the track from spreading. These plates were each secured to the tie by four screens and prevented the tie from being cut by the pressure and impact of the wheels. A member corroborated this showing, saying that in France much importance is attached to the fact that ties which are immunized from decay, really only perish through mechanical action, and that such action is considerably lessened by screws which prevent the rail from battering the ties. The screw fastening referred to was the "Spirale Thiollier," which was illustrated and described in the July, 1905, issue of Railway Engineering and Maintenance of Way.

Further light on French tie practice was given by a member who emphasized the great importance of joining the rail to the tie as closely as possible, the object being to make the contact as if the parts were one, in order to resist to the best advantage the blows received by the ties, and for that purpose he regarded the screw fastening as an excellent one for whatever kind of track is used, since the ties and rails are practically one.

The surprising life of ties on the London & Northwestern Railway of Great Britain, which gave an average of twenty-one years on the main line, after which they had a tenure of from ten to fifteen years more in sidings, was attributed to the fact that the bearing surface on them is very much larger than what it is on the flat bottomed rail, these rails being of the reversible or bull-head type. The bearing area is about two and one-half times that of the flat bottom rail, due to the use of the chair to which the rail is keyed. The chair system is regarded in England as a first-class means to the end of preventing mechanical action between tie and rail, the practice being to use on the road named above, a pad of felt between the chair and tie, the purpose of which is to lessen the wear of the chair into the tie.

In view of the importance of a secure fastening between tie and rail and the difficulty of preserving that condition after it has been attained by our methods of track construction, there can be no more lasting benefit conferred on America railways than by the adoption of a scheme to produce the results shown on French roads, which means not only safety but also reduced expense for maintenance of a detail that is growing scarcer each year.

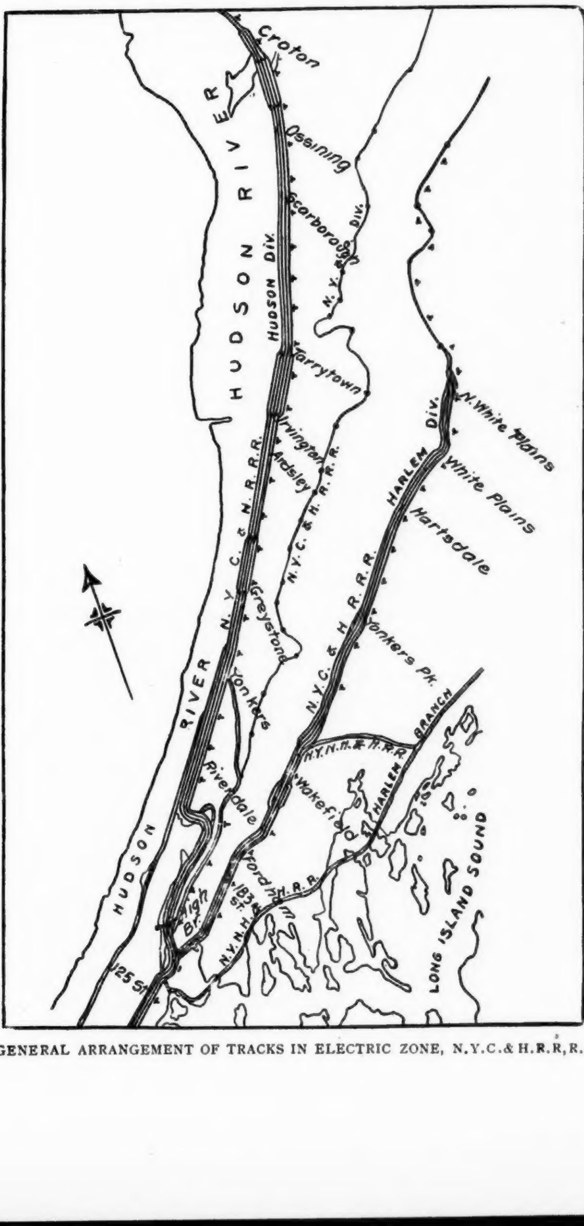
ONE of the lessons taught by the earthquake at San Francisco refers especially to the stability of hollow concrete structures. A four-story paper box factory —one of the largest in Alameda county, built of hollow concrete, and having a larger amount of window opening than usual in any building. This block stood up uninjured, as did also a church built of concrete blocks.

# Signaling in the Electric Zone, New York Central and Hudson River Railroad

THE contract for all block signaling and interlocking in the electric zone of the New York Central and Hudson River Railroad has been awarded to the General Railway Signal Company of Buffalo, New York.

Besides being the largest signal contract ever awarded, this work represents an important advance in the art of signaling. Both block and interlocking work will be all-electric operated by current taken from a power line running the whole length of the system. All track and signal circuits will be operated by alternating current; the only batteries to be used being storage batteries for the operation of interlockings, which will be charged by an AC-DC motor generator drawing current from the power line.

At terminals and on short sections at interlockings it was practicable to give up one of the rails of each track for signaling purposes, but for the greater part of the system it was of considerable advantage to the electric traction system to allow both rails of each track to be used for the return current. The system offered by the General Railway Signal Company, and known as the "Young System," was adopted. Alternating current is used for track circuits in connection with reactance bonds, permitting the passage of the direct propulsion current freely through both of the running rails, while impeding the alternating current used in signaling. This two-rail system was deemed best suited to the conditions.




GENERAL ARRANGEMENT OF TRACKS IN ELECTRIC ZONE, N.Y.C.& H.R.R.R.

Track plans showing the spacing and arrangement of all signals were prepared by the Railroad Company, and together with specifications were submitted to all of the Signal Companies capable of handling the work. Separate bids were requested for the block signaling and the interlocking work.

To assist in finally deciding the system to be adopted, bids for block signaling were requested in eight different forms, covering both normal clear and normal danger systems, all-electric and electro-pneumatic design, and either with one rail of each track given up for signaling purposes or with both rails left available for power return.

Bidders were encouraged to make suggestions as to design and requirements of specifications, so that the specifications might not be considered to act as a restriction on the exercise of their best skill.

In canvassing the proposals the signal committee of the New York Central Lines was called into consultation, and every feature was gone over in detail.

The work included by the contract covers what is known as the electric zone, extending from the Grand Central Station to Croton, on the Hudson division, a distance of thirty-five miles, and from Mott Haven to White Plains, on the Harlem Division, a distance of nineteen miles. Throughout this distance there will be four main tracks, and the work includes about three thousand interlocking levers and one thousand four hundred track circuits, aggregating about two hundred and fifty miles.

The work to be undertaken at the present time covers only that portion of the road to be electrified this year, which carries the work from the Grand Central Station to High Bridge, on the Hudson Division, and to Wakefield on the Harlem Division.

Figure No. 1 shows the general arrangement of tracks in the electric zone, the two main power stations at Port Morris and Yonkers delivering three phase alternating currents of twenty-five cycles and eleven thousand volts pressure, and the various sub-stations at which this current is transformed and converted to direct current at

six hundred and sixty-six volts for delivery to the third rail for operating purposes.

These sub-stations are also equipped with the transformers for the signal service, delivering alternating current at three thousand volts to the signal transmission line, which, although extending the entire length of the district to be signaled, is cut half way between each pair of sub-stations, thus making that portion of the line fed by each sub-station entirely independent of the adjoining one.

The apparatus in each sub-station is properly protected with automatic and hand operated switches, and in order to insure operation, should the alternating current fail, DC-AC motor generators taking current from the storage battery system installed in each sub-station for use of traffic, will continue to feed the signal transmission line with alternating current, and the signal system will continue to work under all conditions under which traffic will be operated. A synchronizer is installed between the transformer and the motor generator set. The three thousand volt transmission line consists of No. 0. bare copper wire, carried on the pole line and in the conduits used for the main transmission system.

Signal bridges are equipped with extension brackets, with cross arms, for convenience in running wire lines to signals. The standard signal bridge is shown in Fig. 2.

For the operation of signal circuits, signal motors, indicators and signal lighting, the three thousand volt current is steeped down to fifty volts, through transformers placed on signal bridges or transmisison line poles. The Secondary of the transformer is provided with a ground connection, former by burying a 2'x3'x1-16" copper plate, to which is brazed a No. 4 B. & S. gauge copper wire.

For track circuit operation the voltage depends on the length of track circuits, and varies from one and a half volts for circuits of two hundred feet to eight volts for circuits of five thousand feet.

The reduction from fifty volts to the track voltage is made by a transformer provided with four taps, which will permit of one type of transformer being used on all track circuits.

In laying out the block signaling plan, the length of the block was determined by the braking distance. For speeds not exceeding forty-five miles an hour the blocks were made twelve hundred feet long; for speeds of between forty-five and sixty miles an hour, twenty-five hundred feet, and for speeds over sixty miles an hour three thousand feet, the average length of the long blocks being about thirty-two hundred feet. All blocks have a full block overlap. A distant signal is provided for each home signal. On account of the density of traffic and the necessity for quick operation the clearing time of signals is limited to three seconds.

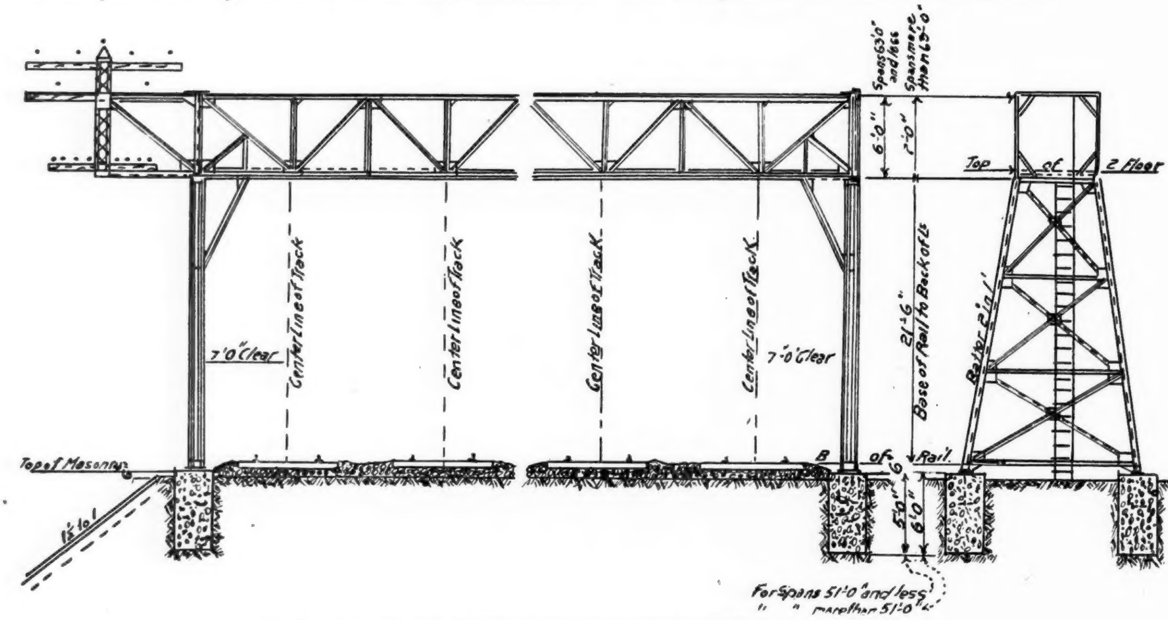



FIG. 2—STANDARD SIGNAL BRIDGE WITH EXTENTION BRACKETS N. Y. C. & H. R. R. R.

The track circuits are of three types. Where they are five hundred feet or less in length, and where the drop in potential in the length of the track circuits is not greater than fifty volts, the "One Rail" system is used, and one rail of the track is given up for signaling purposes and the arrangement shown in figure No. 6 is used. There being no direct current on the signal rail it is not necessary to use any reactance bonds.

On all track circuits over five hundred feet in length, the "Two Rail" system is used, and both track rails are used for the return of the direct power current, and on all of these circuits it is necessary to use the reactance bonds, by which the connection is made around the insulated rail joints, permitting the direct current used in operating to pass, while impeding the alternating current used for track circuit work. The insulated rail

joints are of the Weber pattern with a steel angle plate on the inside.

On track circuits between five hundred and sixteen hundred feet in length the "Two Rail" system is also used and the reactance bonds consist of a copper bar one inch in cross-section and thirty feet long coiled in eight turns around an iron core.

For track circuits over sixteen hundred feet in length a reactance bond formed of a coiled copper bar without any iron core is used.

It will be seen that the block sections are of two types, the one-rail and the two-rail systems. In the former the propulsion current flows along the continuous rail, and in the event of a defect in the continuous rail, this current must avail itself of the conductivity of adjacent tracks, through cross bonding.

In sections of the two-rail system each of the traffic rails of a track forms separate and independent conductors so that if one rail is interrupted, the other would act as a return conductor, even if there were no cross bonding to adjacent tracks.

The use of two styles of bonding was determined by the cross bonding for the electric traction system. The engineering department of the railroad company determined that the distance between such cross bonds should not exceed sixteen hundred feet. For blocks that are sixteen hundred feet or less in length the type of bond allowing cross bonding at the ends of the track sections was best suited to the conditions. For track circuits over sixteen hundred feet in length, where a cross bond between one rail of each track was required every sixteen hundred feet, the ironless reactance bond is the least expensive and the one to be used.

The reactance bonds on all four tracks and also the connections from the bonds to the rail, which consist of bare stranded copper cable of one million two hundred thousand circular mills.

Specifications require that the connections shall not be made within two feet of the rail joint, and that two feet of slack shall be allowed to provide for creeping of rails.

All of the reactance bonds are enclosed in water tight cast iron boxes, set on foundations, the boxes being filled with oil to carry off the heat generated. The bond is designed to permit the continuous passage of three thousand amperes for each rail of the track without injurious heating. The casing of the box is made to cover the terminals and connections to the rail to keep them from being tampered with.

The track relay is of the induction motor type with two field coils. One coil is energized by the fifty volt signal operating current which gives the greater part of the energy required to magnetize the fields and armature.

The other coil is energized by the current from the track rails and this current need only be strong enough to give sufficient magnetism to rotate the armature. The armature revolves through an angle of 37½ degrees, during which movement the contacts are separated through 23½ degrees, and made up through 14 degrees, thus giving a good rubbing contact.

Especially hard carbon is used for the fixed point of the contact while the moving point is of platinum. As the controlled current is an alternating one, there is little sparking, although currents of from 1-6 to ¼ horse power are used.

The box containing the track relay and transformer and the grid resistance has a plug in which an electric light can be cut in for use in night inspection.

The signals are to be of the General Railway Signal Company's motor operated type, with mechanism placed in the base of the signal mast, and worked by a single phase alternating motor of ¼ H. P., using current at fifty volts.

The signals are of the sixty degree two position type, using New York Central standard spectacles and blades, which impose on the signal motor a load equal to the lifting of a seventeen pound weight, at a distance of four feet from the center of the shaft. With this load the motor will clear the signal in from two to three seconds, a square end blade being used on home signals at interlockings, and a pointed end blade used on automatic home block signals.

The circuits by which signals are controled call for a full block overlap, and the control of the distant signal through a circuit breaker on the home signal. The signal lamps are New York Central standard pattern, and are provided with an electric light attachment. The lamps are of four candle power, working on a fifty volt circuit, and are connected in parallel with a fuse cut out, to allow any lamp to be disconnected, without affecting other lamps supplied on the same circuit. The filament of the lamp is wound in a small circle, to bring the point of maximum illumination within the focus of the lens.

The signals to be used in the Park Avenue tunnel will consist of lights only, without any moving parts whatever. Electric lights will be arranged in a box behind lenses of proper color, and the current for the lamps will be directly controlled by the relay contact. Lamps giving the proper color for the stop or caution indication will be lighted when the track relay is de-energized and those giving the proceed indication will be lighted when the relay contact is closed.

With this installation the colors used by the New York Central for the night signal indication will be changed in the electric zone, and instead of using white for proceed and green for caution, the system of using green for proceed and yellow for caution will be used for the first time on this line.

Direct current furnished from storage batteries is used to operate the switch movements and signals. As usual with this type of apparatus the indication is given by the current formed by the motor, which on completing its stroke at the signal or switch movement, is changed to a generator and gives sufficient current to release the lock of the lever of the machine. The current to charge these storage batteries is to be obtained from an AC-DC motor

generator set, taking current from a transformer fed from the three thousand volt signal transmission line and furnishing current of one hundred and fifty volts.

The storage battery consists of fifty-five cells of capacity varying from eighty to three hundred and twenty ampere hours, according to the number of daily lever movements to be made. The average time between charging will be four days.

The motor generators with switch boards will be placed in the basement of tower buildings and a separate battery house will be provided to keep the fumes of the batteries away from the signalmen and the apparatus in the towers.

The interlocking machines are of the usual type made by the General Railway Signal Company and are provided with a latch for each lever to require a definite action on the part of the operator to change the position of the lever. The lever handles are colored according to their functions. There will be a separate lever for each high signal arm and no selectors will be used. Two switches may be controlled on one lever with circuits arranged for this purpose.

The interlocking signals will be of the General Railway Signal Company type with dynamic indication current return. These signals, where slotted, will return to the stop position when the current through the slot magnet is open, but the return indication from the signal motor is not received at the lever until the lever is restored to the normal position.

The operating circuits for the signals are run through controllers on all facing switches in the main line, insuring that the switches are properly set before the signals can be cleared. Block signals on the same mast with distant signals are controlled by a lever in the machine requiring the block signal to be changed to the stop position before a signal can be cleared for a reverse movement on the main line. The advance signals for each track, although operating as automatic block signals, are controlled from the interlocking and are provided with a square end blade to enable the signal man to hold a train, if it is desired to do so. Approach locking will be

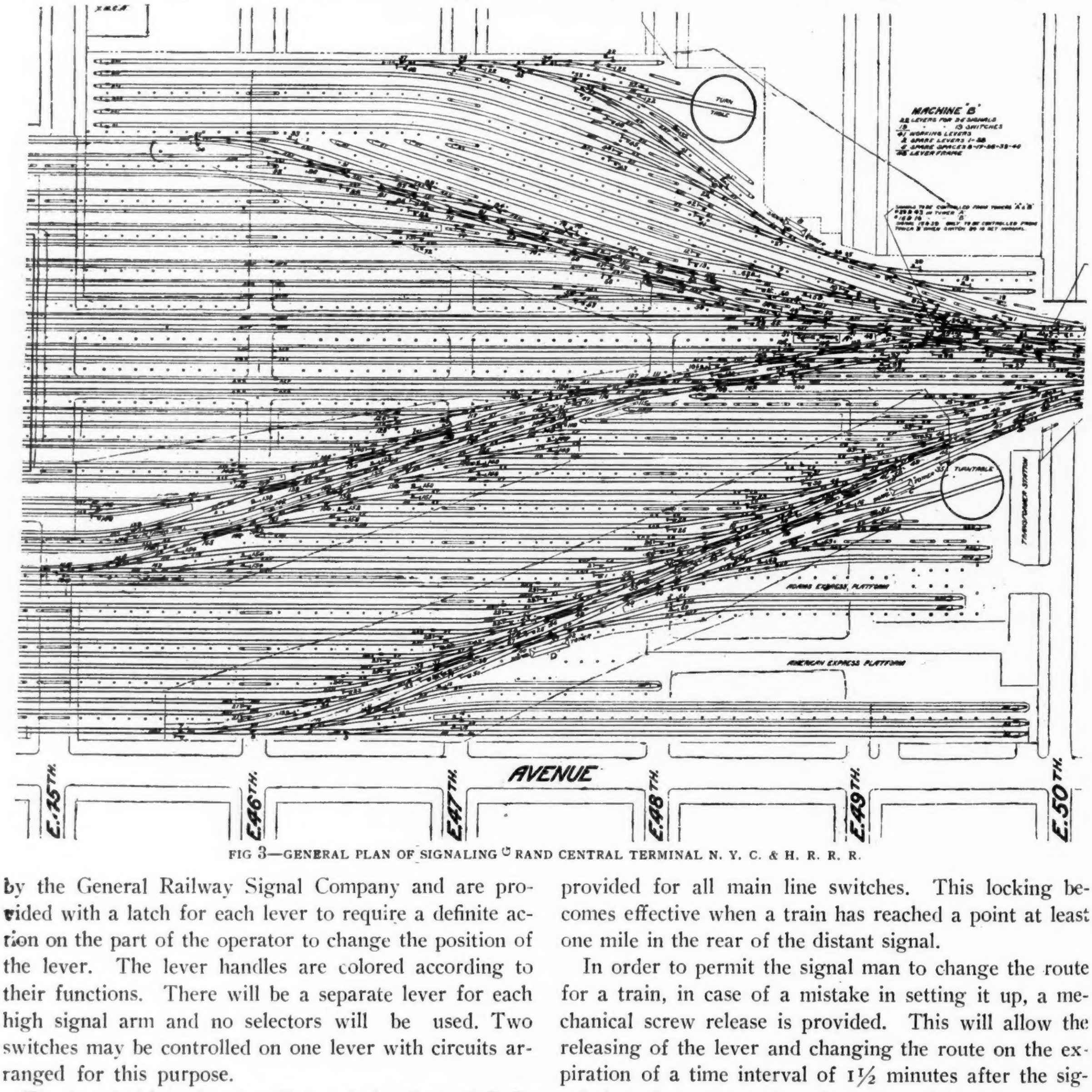



FIG 3—GENERAL PLAN OF SIGNALING GRAND CENTRAL TERMINAL N. Y. C. & H. R. R. R.

provided for all main line switches. This locking becomes effective when a train has reached a point at least one mile in the rear of the distant signal.

In order to permit the signal man to change the route for a train, in case of a mistake in setting it up, a mechanical screw release is provided. This will allow the releasing of the lever and changing the route on the expiration of a time interval of 1½ minutes after the signals have been returned to the stop position. A counter reading to five figures is to be placed on all high signals to register the number of movements.

The movement to be used to operate the switches is of an entirely new type. With the small clearance under

the third rail contact shoe, a mechanism that will not project above the top of the running rail is absolutely necessary. This movement is enclosed in a neat casing with the gear and encasement crank horizontally arranged. The reversible pole changer and indication switch box are also enclosed in the casing with the switch mechanism, protecting these parts and giving an exceedingly neat appearance to the apparatus. The movement is fitted with an improved locking device which, in the case of the plunger catching on the locking rod, as it will do if the switch does not lock up properly, will release the plunger, allowing it to stop while the main part of the movement completes its stroke. The arrangement prevents the motor from forcing the plunger through the lock rod in case it should not have come to the proper position.

The type of dwarf signal to be used is a new one, the signal arm being moved by a motor mechanism arranged horizontally at the base of the post. With this apparatus the indication will be returned to the lever by the current generated by the motor instead of by battery current, as is required with a solenoid mechanism.

In this installation the use of detector bars is practically abolished, a few only being used on the outside rail on sharp curves. Short electric track circuits are provided in their place, effecting the locking of the switches during train movements by controlling the locks on the switch levers. The use of these short track circuits with the controlling wires to the interlocking machine makes possible at small expense the use in the interlocking tower of an illuminated track indicator consisting of a track plan of the interlocking painted on a piece of ground glass with the track circuit sections divided on the back of the glass into separate compartments in which are a red and a white electric light. When the track section is occupied a red light will be shown on the indicator, and when unoccupied a white light will be shown.

In places like the Grand Central Terminal, where the tracks will be entirely roofed over it will not be possible for the signal man to observe the movements of many of the trains; and an indicator of this kind is an absolute necessity to enable him to keep in touch with the situation.

A plan of the signaling in the upper of express level of the Grand Central Terminal is shown in figure No. 3. A preliminary installation is now under way, controlling the movement in the east yard, which will be used as a temporary terminal during the completion of the remainder of the yard.

As in the Park Avenue tunnel the signals in the Grand Central Station interlocking will be shown entirely by lights without any blades or moving parts. In this interlocking work, however, the lever for the signal completes the circuit for the lamps to give the proper color for the indication required. The signal towers will be of brick and of very attractive design, with as much window space as possible.

## *Concrete Blocks for Lining Tunnels*

We reproduce from a recent issue of Engineering News the following illustrations and description of concrete blocks for lining tunnels:

The Mexican Central Ry. has used concrete blocks for the roof lining of tunnels, being cheaper than cut stone. Fig. 1 shows a tunnel with this lining on the Tuxpan-Colima extension, and Fig. 2 shows the forms of the blocks. These blocks weighed about 108 lbs. each, so that one man could handle them and place them in the arch.

The same style of lining was also used for the roof of the Barrientos tunnel, which was completed a little more than two years ago, and whose construction was described in our issue of Aug. 10, 1905. This tunnel was excavated through a kind of porphyry or gneiss rock, full of blind seams. The blocks were formed of a mixture of 1 part of cement, 3 parts of sand, and 6

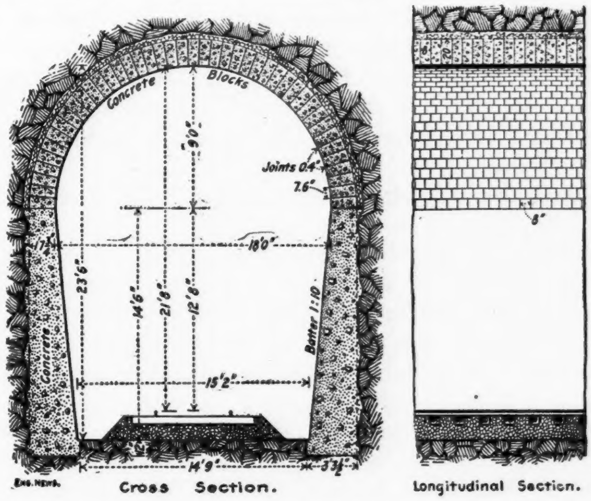



FIG. 1—TUNNEL WITH ROOF LINING OF CONCRETE BLOCKS MEXICAN CENTRAL RY.

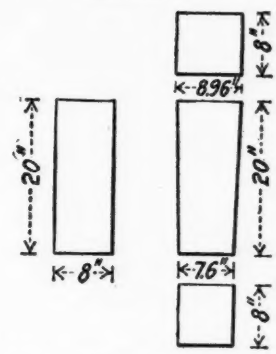



FIG. 2—CONCRETE BLOCKS FOR TUNNEL ROOF

parts of stone broken to pass through a 1-in. ring. The blocks were made in wooden box moulds, and tamped by hand, no machinery being used. They were laid by contract. This tunnel was built jointly by the Mexican Central Ry. and the Mexican National Ry., and the cost to the former was about $315,000 (Mexican currency). For blue prints and particulars of this work we are indebted to Mr. Lewis Kingman, M. Am. Soc. C. E. Chief Engineer of the Mexican Central Ry.

# *The Anatomy of Bridge Work**

By W. H. Thorpe, Assoc. M. Inst. C. E.

THE need for the reconstruction of bridges, arising from various causes which have been treated in the preceding articles, original weakness or faults in design, decay or defects, may also be caused by such extraneous considerations as the growth of loads, widening of the openings spanned, or improvement of the headway.

In cases where disputes with any local authority as to headway are likely to arise, it is prudent to supplement the information as to levels of soffit by rods cut to length in strict agreement with the clear height, before removing the old superstructure.

It is apparent that in cases where the superstructure is already condemned, the detail measurements may be confined to that part of the structure which is to remain, securing only such information as to the work superseded which may be required in arranging for the new work.

In taking particulars of skew bridges, needless as the warning may seem, it is yet necessary to remark that there may be right or left-hand skews which will not reverse. The writer has known a disregard of this to make serious trouble in two instances.

Dealing first with reconstruction of the superstructure of railway under-bridges, these, if small, may not give much trouble, though the demand for greater strength will, perhaps, involve some difficulty in working to the limiting construction depth—*i. e.*, the distance from the top of the rail to soffit of bridge—particularly as many old bridges have a very niggardly allowance in this respect. It may be, and quite commonly is, necessary to

*Fig. 93.*

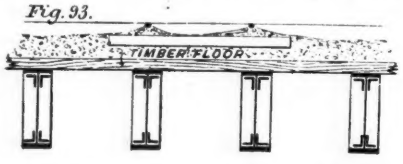
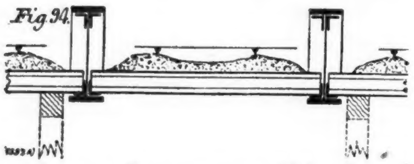



*Fig. 94.*



raise the rails a small amount; or, if headway is not restricted, to lower the soffit. Clearances between the running gauge and girder-work may also be difficult to secure, more liberal allowances being now required than formerly. Complications in the character of the permanent way, so frequently found upon old bridges, should, of course, be got rid of, if possible; but the endeavor may introduce further difficulties. Regard must throughout be had to the methods to be adopted in removing old work and in erecting the new. Perhaps the simplest case to deal with is that where girders lie parallel to, and under the rails, with a timber floor upon which the permanent way is carried, as sections of the road involving pairs of girders may be readily removed, and replaced by the new girder-work. (See Fig. 93.) If the deck be of trough flooring or old rails, the matter may not be so

*Fig. 95.*

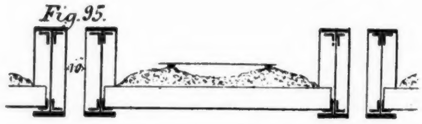
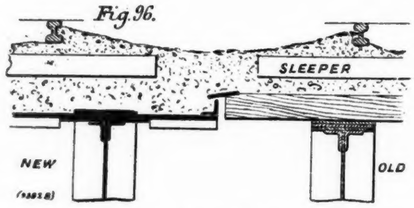


*Fig. 96.*




simple, as regard must then be had to the position of joints in the existing floor, and the new work be schemed with respect to the number and office of girders which may be got in at any one breaking of the road. A slight slewing of rails may sometimes be resorted to on occasion, where this has the effect of releasing some part of the work not otherwise to be dealt with.

Bridges having main girders, with timber or trough flooring resting upon the bottom flanges, or suspended by bolts, will, if carrying many roads, cause some little difficulty, as the dismantling of any one span involves the disturbance of others; where, however, many lines are concerned, it may be feasible to put one or more temporarily out of use, preserving the continuity of traffic over those which remain, but refraining from any diversion of the more important roads.

Somewhat similar troubles occur where main girders with cross-girders at the lower flanges are found, particularly if the cross-girders are arranged in line, the ends abutting on each side of the same main girder webs. It is seldom, however, that this construction is used in bridges of small span carrying many roads; but where it does occur, it may necessitate the use of timbering below, to carry the ends of cross-girders when freed from their supporting main girders. (See Fig. 94.)

If it is proposed to use new main and cross-girders, it is desirable to arrange these in the manner already recommended, the cross-girders not in line; this has peculiar advantages in reconstruction work, as the bolting-up and riveting of the cross-girder ends is not hampered by other cross-girder attachments, leaving each piece of floor complete in itself. Twin main girders are occasionally used with the same object, and present the advantage of simplicity in erection and independence of one

*Extract from a series of articles running in "Engineering" ( a London paper) by W. H. Thorpe, Assoc. M. Inst. C. E.

span from those adjoining (see Fig. 95); but the method is wasteful of space, and involves a somewhat greater total weight in the main girders.

The foregoing observations apply more generally to small single-span bridges, the operations on which may be effected without any material disturbance of traffic arrangements; though this can seldom be wholly avoided, it should be confined, where practicable, to a few hours on a Sunday.

The reconstruction of bridges over 70-ft. span may have to be dealt with under more elaborate arrangements, if carrying two lines only, possibly with single-line working for a period more or less protracted; or it may be necessary, having regard to the weight of main girders to be removed, to carry the whole structure upon temporary staging, supporting the road independently, cutting up and removing the old work, and later putting the new work in place, either by detailed erection in its ultimate position, or by erection at one side and drawing across. The latter method is, however, commonly reserved for cases in which no special staging is used under the old structure.

Bridges of a number of openings are usually dealt with by securing full possession of one road at a time, which for double-line bridges necessitates single-line working. It is commonly out of the question, even with moderate spans, to deal with some of these only at a time, and so avoid continuous possession of one road, for a lengthened period; and it can only, as a rule, be managed where the ends of the new main girders do not in any way interfere with those of the old, and where it is not necessary to re-set bed-stones, or make other alterations in the bearings which necessitate the complete clearance of the pier-tops. In exceptional cases, it may be found possible to arrange for the complete removal of a small number of moderate spans on a Sunday, and the putting in place of the new work, as in the case of small single spans.

Spans erected to one side of the final position, to be later travelled across, are commonly mounted upon gantry staging, and up to 50 tons weight may rest directly upon rails well greased. The power adopted to move the span is usually that of screw or hydraulic jacks, or occasionally engine haulage, special tackle being in that case necessary to apply the engine power is the right direction. If the time is limited, or weight considerable, a more elaborate arrangement, by which the load is supported upon wheels, may be necessary, with a view to reducing the resistance to a manageable amount. All work which it is possible to do before shifting into place, includisg the permanent way, where this is of special character, should be executed in advance, leaving only the rail connections to be made good when the span is in position.

Where timber staging is used to carry the permanent way before dismantling an old structure, it is convenient to begin by placing stout balks of timber under the sleepers from end to end of the bridge, or directly under the rails if space is limited; the staging is then arranged to give support to the running timbers.

Metallic under-bridges of ample headway, perhaps over coal-workings (since settled down), or for some less sufficient reason made of metal, may cheaply be replaced by brick arches built below the old superstructure, the springings of the arch being checked isto the face of the existing abutments. With stout walls, careful work and good material will make this an efficient and durable job.

It being a primary condition of reconstruction work to interfere but little with ordinary traffic arrangements, single-line working is avoided wherever practicable; as this, always objectionable, may necessitate the erection of special signals and signal apparatus, besides the temporary remodeling of the roads, and in this country it may involve a Board of Trade inspection—altogether a troublesome and expensive business.

Fig. 97.

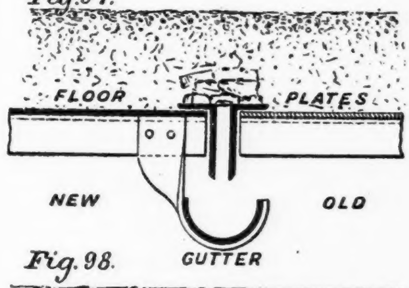
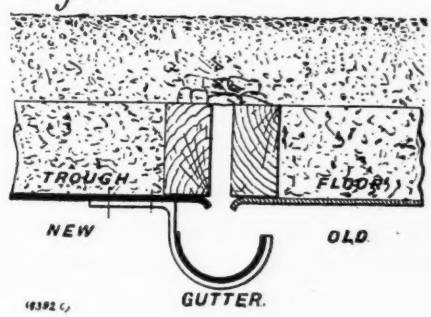



Fig. 98.




Any bridge work which is accompanied by breaking or blocking the road can only be undertaken by arrangement with the traffic department, after notice duly given and published in the periodical record of such matters, it is generally fixed for a Sunday. Preparatory to this, it is necessary to make all ready by getting as much done beforehand as is possible. Wherever practicable and prudent, the whole work is released from its surrounding, masonry cut away, rivets cut and replaced by good bolts, nuts removed from holding-down bolts, or the bolts cut through, etc. Particular care should be exercised to ascertain what remains to be done immediately prior to removal. It is necessary further to arrange for trucks to be in readiness to receive old material, and others containing new girder-work to be conveniently stationed, having been loaded up to come right and foremost; engine power, cranes, empty and loaded trucks, being all marshalled and so placed as to be available in proper order, and as wanted. There must be no mistake

as to what roads will be fouled by swinging the crane with its load, or as to the reach of the crane in effecting its work.

The whole operation to be conducted on any Sunday should be well within the resources of the men and plant engaged in it; or so managed that it is a matter of no serious importance if the whole cannot be completed as originally desired.

Possession of the roads to be blocked having been secured between certain hours, if some part only of the work to be carried out has been completed as the time grows short, any attempt to execute the remainder may result in checking trains until such time as the line may be reported clear—a contingency to be avoided—though the temptation to save another Sunday's work by delay of a few minutes to some one train may be considerable.

In scheming any reconstruction, it may be insisted that at least one feasible method of carrying out the work must be secured, though it is the writer's experience that frequently some other method than that contemplated is in the end adopted, when, some months later, the final arrangements for fixing are made. The tendency of a zealous erector is commonly to take full advantage of any facilities offered, with a view to a moderate amount of work to be done at any one time and to achieve as much more as he can himself secure by scheming, or a liberal use of labor; all Sunday work, with attendance of engines and cranes, being of necessity expensive.

Railway over-bridges do not commonly present any particular difficulties. The spans to be dealt with are usually small, and the weights to be lifted moderate. The height above rails may, however, be above the lift of any crane; and, for the purpose of raising main girders, a derrick may become necessary, the rearing and guying of which may block many roads during the time it is in use. The girders of larger spans, too unmanageable to be lifted whole, may be erected upon staging; to secure the requisite headway it may be necessary to build the girders at a level above that at which they will finally be, lowering them into position when self-supporting, and after the removal of the staging.

*Fig. 99.*

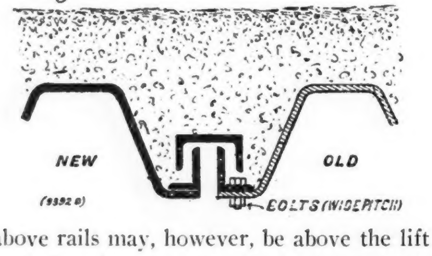
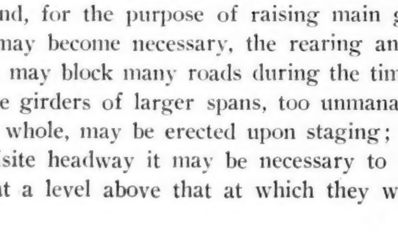
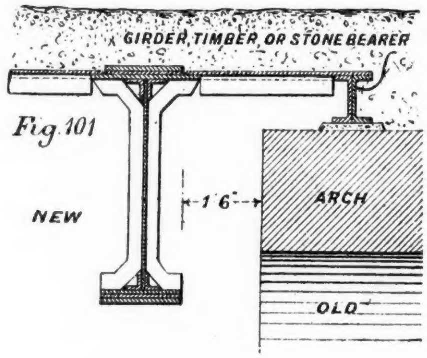
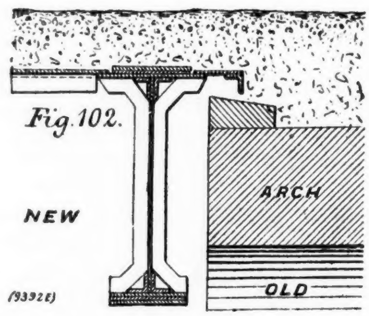



*Fig. 100.*




The widening of railway under-bridges is, as a rule, a matter of no special difficulty, but some remarks may be of use. Widenings should be planned with a regard to later reconstruction of the original bridge, if that is at all likely to be necessary, and with the object that, when complete, the whole should be a consistent piece of work.




It may, indeed, happen that widening of a bridge may involve the remodelling or reconstruction of the old work, to enable the new roads to be laid down as desired; this is more likely to be necessary where there exist main girders not competent to take any additional load, and to duplicate which would sacrifice space between the new and old roads; or may be unavoidable because of slewing of the old rails, as part of a general rearrangement.

Dealing with widenings simply, there is often some little trouble in contriving a connection between the new and the old work, as this may have to be made under, or close to, the sleeper ends of the existing roads. It is desirable to arrange this part so that no drilling of old work for rivets or bolts shall be necessary, there being, in fact, no strict connection. By judicious scheming this may be effected, whilst securing freedom from leakage of water at the joint. (See Figs. 96 and 97). If tying of the new and old structure is desired, this can usually be done quite simply, well below the floor, at some more accessible level.

The strict jointing up of trough flooring, new to old, at right angles to the troughs, cannot be contemplated, but may be dealt with by treating each part independently, the ends being near together, separated by a space of an inch or so. Each trough end being closed by a dia-

phragm or oak block to prevent ballast dropping through, the top of the space may be covered by a loose strip, secured to prevent it shifting, the bottom provided with a gutter of liberal dimensions to take away leakage, as it is practically impossible to make this arrangement "drop dry" under the conditions common in executing work of this kind. (See Fig. 98).

Where trough flooring, new and old, has to be made good parallel to the troughs, the difficulty of making a direct connection is less marked, and it is not unusual to introduce a strip cover simply; but if accessible the work is still troublesome, as there is commonly a want of strict alignment and truth as to level between the new and the old troughs. It is preferable to arrange for junctions of a more convenient type, as in Figs. 99 and 100.

When widening masonry arch bridges by girderwork, it is desirable to ensure that any girders parallel to the masonry face shall be sufficiently far removed from it to enable painting to be executed. The space remaining between the girder and the arch may then be bridged by floor-plates, or an extension of the timber floor, if that is adopted.

In effecting a junction such as this the writer has used the arrangement shown in Fig. 101, the advantage being that the piece of connecting floor is sufficiently wide, and

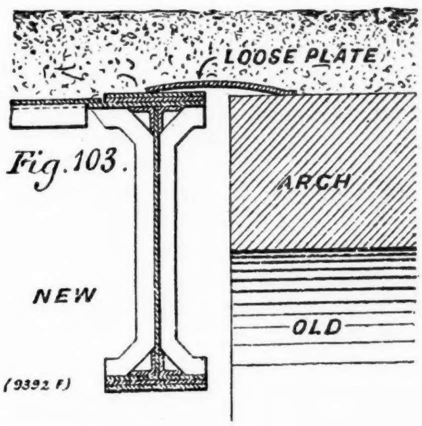


Fig. 103.

also sufficiently flexible, to allow the girder-work freedom to deflect without doing harm. The load carried by the width of floor is, as to one part, delivered well on to the old masonry, in preference to being imposed near to the face. If it should for any reason be imperative to place the girder close to the arch face, it is preferable to scheme the floor so that there shall be no actual contact, the new floor in that cast slightly overhanging the masonry, as in Fig. 102, or dealt with as in Fig. 103, if depth is restricted.

The widening of masonry arch bridges calls for no other remark than that the new work should be free from the old; though it may be advisable, when the widening is narrow, to tie the new work to the old in such a way as to permit independent settlement.

If the widening is exceptionally narrow, there may be no choice but to bond the new and old work together, and in the best manner, with the object of minimizing the risk of separation.

The above matters relative to widenings, though apparently trifling, may by neglect cause much trouble and expense in maintenance. They principally concern small bridges, the extension of larger structures coming rather in the category of independent works.

THE handling of mail through the tunnels under the streets of Chicago has been inaugurated, the first train hauling mail being run from the Postoffice to the LaSalle street station on July 16. The service is to be extended as rapidly as possible, and it is thought that by the first of October the Union, the Dearborn, the Grand Central, the Illinois Central and the Chicago & Northwestern stations will be served. This method of handling the mails between the railroad stations and the Chicago Postoffice will greatly facilitate the delivery throughout the city.

Work is progressing rapidly on the terminal which is being built at Washington, D. C., by the Pennsylvania and Baltimore & Ohio Railroad. Concrete foundations about 45 ft. deep have been placed. The filling within the limits of the terminal amounts to 900,000 cu. yds. An immense amount of material is required in this work, and there has been delivered at Washington, for use in the construction of the station: 233 cars fireproofing materials; stone and ballast screenings, 1,250 cars; sand, 3,000 cars; cement, 1,370 cars; cinders, 5,000 cars; brick, 1,160 cars; structural steel for building, 380 cars; structural steel for bridges and girder-covered way, 300 cars; granite, 425 cars; new rails, 210 cars; old rails, 65 cars, and large amounts of other railroad accessories. The north approach includes a train-yard of 33 tracks, a power plant, an express building, a coach-yard having a capacity of 750 cars, an engine and repair yard with engine house and shop facilities.

## Casper Teiper

IN the death of Casper Teiper, president of the Buffalo Structural Steel Company, the engineering fraternity loses one of the most versatile technical minds that the hard school of experience has produced in this country. Though a self-educated man, he was in addition to being an accomplished bridge designer and builder, an expert in the theory and practice of mechanical engineering, a knowledge that he often used in designing tools and machinery required in furtherance of bridge work. Some of the work showing his ability along diverse lines is seen in the sheathing of the Port Huron tunnel and in steel steamers on the Great Lakes, though his strength was in the science of bridge engineering in which he was thoroughly grounded by close study. He was a member of the Engineers' Society of Western New York.

### *Personals*

Mr. H. E. Rhoades has been appointed division engineer of the Illinois Central at Freeport, Ill.

Mr. C. K. Lawrence has been appointed chief engineer of the Central of Georgia to succeed Mr. Henry M. Steele, resigned.

Mr. A. E. Tripp has been appointed supervisor of water service of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

Mr. H. S. Rogers has been appointed engineer maintenance of way and construction of the Illinois, Iowa & Minnesota, with office at Rockford, Ill.

Robert B. Burns, chief engineer of the Coast Lines of the Atchison, Topeka & Santa Fe, died at Los Angeles, Cal., on June 21, at the age of 53 years.

Mr. J. A. Lahey has been appointed roadmaster of the Rio Grande division of the Atchison, Topeka & Santa Fe at Rincon, N. M., succeeding Mr. J. Quinn.

Mr. W. F. Hannes has been appointed consulting engineer of the Coahuila & Zacatecas, with office at Saltillo, Mex., to succeed Mr. H. Scholfield, resigned.

The headquarters of Mr. Thomas Bernard, engineer of maintenance of way of the Southern, have been removed from Greensboro, N. C., to Danville, Va.

Mr. W. S. Perdue has been appointed acting roadmaster of the Panhandle division of the Atchison, Topeka & Santa Fe at Wellington, Kan., vice Mr. R. Meade.

Mr. Henry M. Steele, who recently resigned as chief engineer of the Central of Georgia, has been appointed chief engineer for J. G. White & Co., of New York.

Mr. F. Flaiz has been appointed acting roadmaster of the New Mexico division of the Atchison, Topeka & Santa Fe at Las Vegas, N. M., vice Mr. D. Elliott.

Mr. G. H. Herrold, division engineer of the Chicago Great Western at Red Wing, Minn., has been appointed to take charge of the double tracking between Chicago and Oelwein.

Mr. W. S. Dawley has resigned as chief engineer of the Chicago & Eastern Illinois to become chief engineer of the St. Louis & North Arkansas, with headquarters at St. Louis, Mo.

Mr. F. M. Edwards has been appointed engineer of maintenance of way of the western district of the Southern Ry., with office at Chattanooga, Tenn., to succeed Mr. P. S. Fitzgerald, resigned.

Mr. F. E. Paradis, formerly chief engineer of the Chicago Terminal Transfer, has accepted a position with the New York Central & Hudson River, in charge of the construction of the new yard at Buffalo, N. Y.

Mr. J. B. Moll, general roadmaster of the Chicago, Milwaukee & St. Paul, having been assigned to other duties, the office has been abolished and the duties have been assumed by the engineer of maintenance of way.

Mr. A. P. New has been appointed roadmaster of the Southern at Birmingham, Ala., in place of Mr. J. N. Biddy, who has been transferred to Atlanta, Ga., in a similar capacity, succeeding Mr. J. S. Lemon, who has been appointed engineer of maintenance of way of the eastern district.

Mr. John Hall has been appointed division engineer of the Cleveland, Cincinnati, Chicago & St. Louis, in charge of construction on the Cairo division, in place of Mr. F. W. Smith, who has been transferred to Cincinnati, O., as assistant engineer.

Mr. C. E. Hawkins, formerly chief engineer of the White Pass & Yukon, has been appointed chief engineer of the Oregon & Washington, which is to be built by the Harriman interests from Portland, Ore., to Seattle, Wash. Headquarters, Seattle.

Mr. John Cronin, division roadmaster of the Rio Grande Western at Salt Lake City, Utah, has been appointed general roadmaster, with headquarters at Salt Lake City. Mr. John Fogarty has been appointed division roadmaster to succeed Mr. Cronin.

Mr. H. E. Newcomet, engineer of maintenance of way of the Pennsylvania Lines west of Pittsburg (Northwest System) at New Castle, Pa., has been appointed acting engineer maintenance of way at Cleveland, O., in place of Mr. H. E. Culbertson, granted a leave of absence.

Mr. Henry Rohwer, consulting engineer of the Missouri Pacific, has resigned, and has opened up an office as consulting engineer at 1212 Chemical Building, St. Louis, Mo. Mr. Rohwer has been connected with the Missouri Pacific System since 1887 and much of the recent work on new lines, as well as betterments on the old lines, has been done under his supervision.

Mr. James R. De Remer, the well known civil engineer, died at Denver on July 26. He achieved considerable distinction in handling difficult problems in railway location and construction in mountainous regious, and was one of that class of engineers who established precedents. It was he who built the famous hanging bridge in the Royal Gorge, on the Denver and Rio Grande.

Mr. W. H. Chadbourn of Beaver, Pa., where he has been engaged in the United States government survey service, has been appointed chief engineer of the Chicago Great Western, with headquarters at St. Paul, Minn., vice Mr. A. Munster, resigned. Mr. T. H. Bacon, heretofore assistant division engineer, has been appointed assistant chief engineer, with office at St. Paul, Minn. Effective on July 16.

The following changes in the organization of the engineering department of the Chicago & Northwestern are announced, effective on July 16: Mr. W. J. Towne, engineer of permanent improvements at Chicago, is appointed engineer of maintenance of the lines east of the Missouri River. Mr. A. A. Schenck, division engineer at Omaha, Neb., is appointed engineer of maintenance of the lines west of the Missouri River.

### *The Values of Ties of Different Materials*

In Bulletin No. 75 of the American Railway Engineering and maintenance of Way Association Mr. W. C. Cushing, chief engineer of maintenance of way, Pennsylvania Lines West of Pittsburg, Southwest System, contains a series of tables showing the cost delivered which a white oak tie, lasting 10 years, must reach before it will be economical to use other kinds of tie; how long ties of different materials must last in order to be as economical as white oak costing 70 cents and lasting

10 years; and the first cost which can be paid for different kinds of ties in order to be as economical as white oak costing 70 cents and lasting ten years. Mr. Cushing also states that some of the data used are costs established from actual practice and from reliable information given, while in other cases assumptions have been made from the best information available, and from these the following deductions have been made:

With white oak ties costing 70 cents delivered on the railroad, it is economical at the present time to buy inferior woods at a price not to exceed 50 cents, have them treated with zinc-chloride or zinc-tannin (except where it is necessary to use them on oak ties), and use a standard railroad spike. A life of ten or eleven years has been found to be a maximum for such ties without the use of tie-plates and better fastenings, and if the life of ten years is not attained, there will be that much loss to the company.

When a white oak tie reaches a cost of 86 cents or 87 cents delivered on the railroad, it will be economical to use the zinc-creosote process or straight creosote costing 30 cents, if the tie costs 46 cents delivered on the railroad and will last sixteen years; or, it will be economical to use straight creosoting costing 85 cents for treatment if the tie can be made to last thirty years, which is French practice, before the oak tie reaches a cost of 80 cents delivered on the railroad. In both of these cases, it is assumed that tie plates, wood screws and helical linings are used because ties cannot be made to last more than ten or twelve years without the use of proper fastenings, since, otherwise, the tie will be destroyed by mechanical wear. It is necessary, therefore, to use improved fastenings when we expect to obtain a life of ties greater than ten or eleven years.

It will also be economical to use a steel tie costing $1.75 delivered, if it will last twenty years.

When the white oak tie reaches a cost of 90 cents delivered on the railroad, it will be economical to use either ties of inferior woods treated with zinc-tannin if a life of fourteen years can be obtained, the improved fastenings being used; of a concrete tie costing $1.50 if it will last twenty years.

When the price of white oak ties reaches $1 it will be economical to use a steel tie costing $2.50 if it will last thirty years, a concrete tie costing $2.25 if it will last thirty years, or an inferior wood tie treated with zinc-chloride if a life of twelve years can be obtained.

With ties of inferior woods costing 46 cents delivered on the railroad we must obtain a life of from eighteen to twenty years, whether treated with zinc-chloride, zinc-tannin or zinc-creosote, to make them economical as white oak ties costing 70 cents. It is assumed, of course, that they must have the most approved fastenings in order to attain an age as great as that.

With inferior woods costing 46 cents delivered on the railroad, and if the creosoting costs 30 cents, it will be necessary for us to obtain a life of twenty-one years in order to make them as economical as white oak ties costing 70 cents delivered.

With inferior wood ties costing 46 cents delivered, and with the creosote treatment costing 85 cents, as in French practice, it will be necessary for us to obtain a life of thirty-six years from the ties in order to make them as economical as white oak ties costing 70 cents delivered.

With steel ties costing $1.75 each delivered, it will be necessary for us to obtain a life of twenty-eight and a half years in order to have them as economical as white oak ties costing 70 cents delivered. This price is a little less than the cost of the Buhrer steel ties in the tracks at Emsworth.

With concrete ties costing $1.50 each delivered, it will be necessary for them to last twenty-eight years before they will be as economical as the white oak ties costing 70 cents delivered.

With steel ties costing $2.50 delivered and concrete ties costing $2.25 delivered, which are approximately the prices of the Seitz steel tie and the Buhrer concrete tie, in the tracks at Emsworth, it is necessary for them to last over fifty years each in order to make them as economical as the white oak ties costing 70 cents delivered.

In order to make treated inferior woods as economical as white oak costing 70 cents delivered, when the treated ties are equipped with proper fastenings in order to make them last as long as has been found practicable by experience, we can only afford to pay for the ties delivered on the railroad, 10 cents each when treated with zinc-chloride; 20 cents each when treated with zinc-tannin, or creosoted at 30 cents; 23 cents each when treated with zinc-creosote, and 29 cents each when creosoted in accordance with French practice.

In order to make them as economical as white oak ties costing 70 cents delivered, we can only afford to pay $1.48 each for steel ties which last twenty years, and $1.79 each when lasting thirty years.

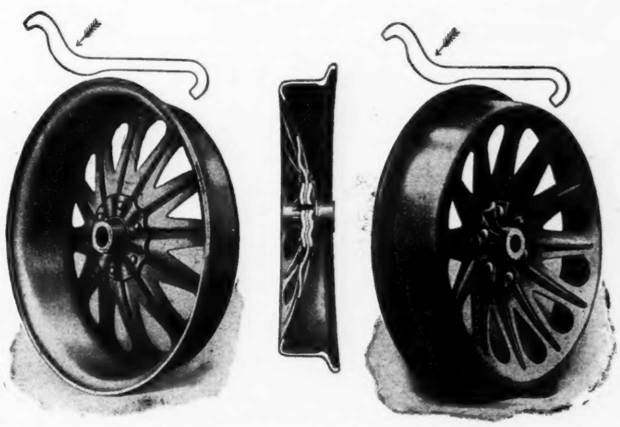
In order to make them as economical as white oak ties costing 70 cents delivered, we can only afford to pay at first cost of concrete ties delivered, $1.15 each, if they last twenty years, and $1.57 each if they last thirty years.

We know nothing about the life of concrete ties, and it is at least very desirable to experiment with them for yard side tracks, even though we do not use them in the main tracks, because they might lie undisturbed in yard tracks for many more years than they would in main tracks.

When white oak ties are costing 70 cents delivered (about present prices), we can afford to buy inferior oak and other hard woods at 45 cents to 50 cents (present prices), and have them treated with the zinc-tannin or zinc-chloride processes, and only use common spike fastenings.

## *Kalamazoo Improved Pressed Steel Hand Car Wheel.*

The illustrations herewith show the new improved pressed steel hand car wheel, which is manufactured by the Kalamazoo Railway Supply Co., Kalamazoo, Mich. The wheel is an important feature in the construction of handcars and push cars because it receives more wear than any other part, and is, therefore, the greatest item in the maintenance of the car. To meet the demand for a longer lived wheel the company has designed and placed upon the market the Kalamazoo improved pressed steel wheel (patented). One of the principal faults of all pressed steel wheels hitherto invented is the tendency to quickly wear through in the throat of the flange, due to the thinness of metal at that point. The flange then breaks off, necessitating the discardure of the wheel. By the use of special machinery, constructed fot this particular purpose and protected by patents, the mteal in the Kalamazoo wheel is gathered so as to increase its thickness 1-8 of an inch to 3-16 of an inch in the throat of the flange. In other words, the metal being 1-4 of an inch thick in the tread, is nearly



KALAMAZOO PRESSED STEEL HAND CAR WHEEL

double that thickness in the flange and at the throat. Thus plates are sheared into circles, shaped at proper heat under hydraulic pressure, then re-heated and run through a finishing machine, which gathers and increases the thickness of metal in

the flange as described above. From the finishing machine the wheel passes at red heat into another hydraulic press holding male and female dies that are used for sizing purposes, so that when completed all wheels are exactly the same diameter and circumference. Therefore, it is not necessary to grind or true the wheel in a lathe, which destroys the hardened skin of the steel and impairs its durability. The method of finishing the wheel by rolling makes the metal harder than the original plate and the tensile strength and the wearing qualities are thereby increased. The metal is compressed in each operation making it more dense and strong, in the usual method of manufacture the metal being drawn or stretched. The hub and riveted flange are pressed into place and riveted cold under hydraulic pressure. In the wheel the web is given considerable dish toward the center and this with the deeper and stronger corrugations greatly increases the weight bearing qualities, and makes a better and stronger hub fit. The flange of the Kalamazoo wheel conforms to the M. C. B. standard in height and thickness and does not form a receptacle for the collection of dirt. The deep corrugations in the web of the wheel extend through to the hub, and the two hub flanges being corrugated form a perfect fit, interlocking with the corrugations in the web, thus preventing the shearing of the rivets. These wheels when desired may be insulated as perfectly as a wood center wheel.

## *Railway Signal Association Questions*

A committee of the Railway Signal Association on "Storage Batteries for Railroad Signaling," of which I. S. Raymer, Pittsburg & Lake Erie Railroad, Beaver, Pa., is chairman, has sent out to members a series of 249 questions covering in minute detail the formation and construction, insulation, jars and tanks, housing, electrotype, installation, central charging stations under direct line wire and portable storage battery systems, maintenance, tests, records, etc. If these questions are answered with any degree of completeness by the members, the committee on this subject should be able to present a very full and up to date report at the annual meeting of the association in October.

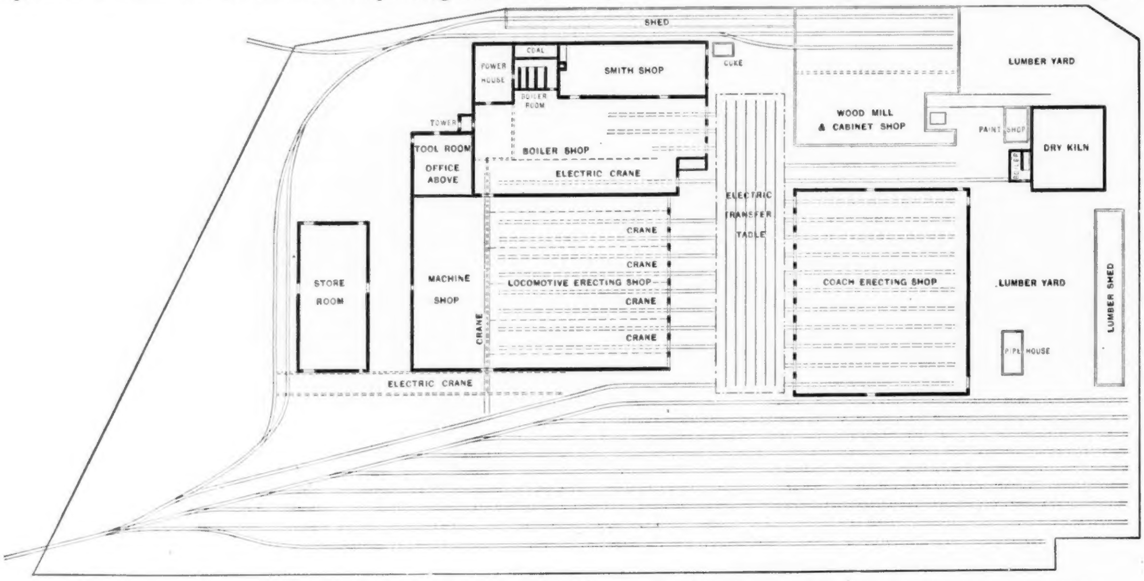



FIG. 2—GENERAL PLAN OF LOCOMOTIVE AND COACH DEPARTMENT (WEST WORKS) OF PRESENT HICKS LOCOMOTIVE AND CAR WORKS

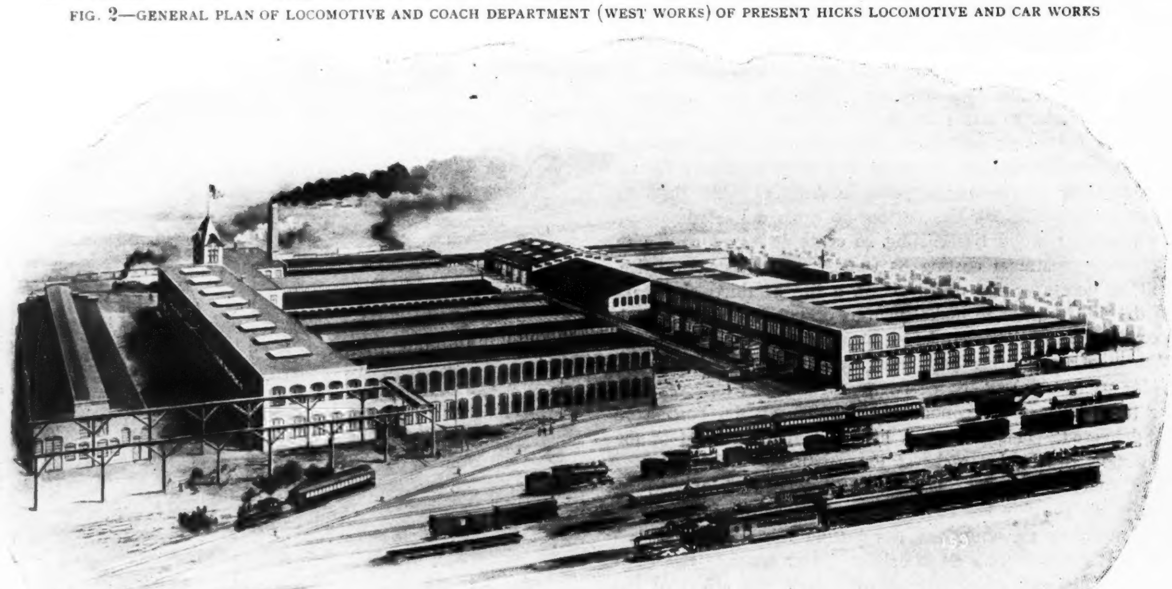


FIG 3—GENERAL VIEW OF BUILDINGS IDICATED IN FIGURE 2

## *Hicks Locomotive and Car Works*

While most railway men have a vague idea that outgrown locomotives and cars are bought by firms handling second-hand equipment and by them sold to small lines, new lines, contractors or firms needing small or cheap equipment, yet few have much realization of the extent to which this business has been developed by at least one firm. For this reason it may not be out of place to pause a moment and regard this industry, for, by reason of the repair plant development found necessary to handle the work, a veritable industry it has become. With this in mind the plant of the Hicks Locomotive and Car Works was recently visited.

FIG. 4—TRANSFER TABLE SIDE OF HICKS LOCOMOTIVE SHOP

The plants shown in the ensuing illustrations are entirely the result of the business begun in 1897 by Mr. F. M. Hicks in the modest way indicated in the first illustration. This first building was secured and equipped by Mr. Hicks on realizing that the nature of the business demanded an abandonment of the (at that time) usual policy of depending upon the selling railway company for the necessary repairs. The result of this move was an immediate expansion of the business; which has continued until at the present time the two plants shown in the illustrations, designated respectively as the West Works and the East Works, have been developed to meet the demands. Also, the business was incorporated in May of this year with a capital of $1,200,000, with F. M. Hicks as president; Elliot C. Smith, vice-president; William McInness, treasurer; E. H. Norton, assistant treasurer, and C. A. Ralston, assistant to the president. Furthermore, at the present time the business of the company not only includes the brokerage of second-hand equipment, but the taking of large or small contracts for the repair of locomotives and cars and the building of new equipment, particularly passenger and freight cars, while over 900 men are employed in the two plants.


FIG. 1—BEGINNING OF HICKS LOCOMOTIVE & CAR WORKS

The locomotive and coach work is conducted in the West Works, of which a plan is shown in Fig. 2 and a general view in Fig. 3. The locomotive shop is a one and two-story building, with erecting pit capacity for 24 locomotives in the single-story section 170 by 250 feet. The double-story section is 65 by 170 feet, in which the machine shop occupies the lower floor and the tin shop, brass and buffing departments the upper floor. Adjoining this building are the boiler and smith shops, located in a building 50 by 230 feet. All erecting pits are served by overhead hand cranes, while a 6-tons capacity electric telpher system connects the boiler shop, erecting and machine shops with the storage yard outside, which latter is served by an electric traveling crane commanding the 68x140 feet two-story stores building.

A 70-foot electric transfer table serves both the locomotive and coach departments, the buildings for the latter comprising an 11 pit, two-deep, coach erecting shop 170 by 197 feet, a wood

FIG. 5—ERECTING SECTION HICKS LOCOMOTIVE SHOP

mill and cabinet shop 70 by 158 feet, a tender shop 60 by 158 feet, and a dry kiln and lumber shed 68 by 80 feet. Views of various scenes in and around these buildings are presented in Figs. 4, 5, 6, 7 and 8. The power plant comprises 600 H. P. in three tubular units, two 200 H. P. Ball, tandem compound engines, belt-driving four 75 K.-W., D. C. generators and an air compressor of 600 cubic feet free air per min. capacity. The smith shop recently received a Bement-Mills steam hammer. This additional equipment renders the plant adequate for demands upon it of about 125 locomotives each year in addition to the repair work for a number of large roads, including the Missouri Pacific, Chicago & Eastern Illinois and Cincinnati, Hamilton & Dayton; about 100 rebuilt coaches and approximately an equal number of new cars annually.

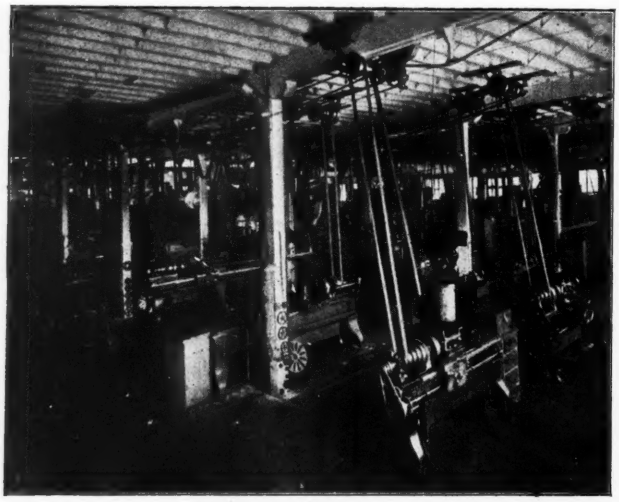


FIG. 6—MACHINE SECTION OF HICKS LOCOMOTIVE SHOP

FIG. 7—ROD DEPARTMENT OF HICKS LOCOMOTIVE SHOP

FIG. 8—VIEW IN ERECTING SECTION OF HICKS COACH SHOP

machine tool equipment provided the various departments is most complete, among the latter purchases of which may be mentioned a 78-inch Pond boring mill, a 42-inch boring mill, a 6-tons Northern Engineering Works telpher hoist, a Fosdick & Holloway 72-inch radial drill, a 30 by 30 by 8 foot Gray planer, a Le Blond No. 3 milling machine, a National triple head bolt cutter for the locomotive department. A 12-spindle nut tapper was converted into a staybolt threader and a 19-tons hydraulic press was home made for this department. The boiler shop equipment has also recently received a Wangler rotary beveler, a Kling Bros. punch and two Bradley hammers, while a sill machine and sash sticker went to the wood mill.

The East Works plant is devoted entirely to freight car repair and new construction; the present capacity in the latter line being some 15 cars a day. The plan is shown in Fig. 9 and a general view in Fig. 10. The 180 by 400 foot steel car repair and erecting shop indicated has only progressed as for as the foundations, yet while the 40 by 60 foot storehouse construction has not had its superstructure raised, though the work on both is being energetically prosecuted. The buildings are located on a 28-acre tract of ground adjoining a controlled tract of 38 acres for future extensions. The buildings now in service comprise a building 65 by 220 feet devoted to the uses of a truck shop and sill and bolster mill. This building is served through-

out by an overhead Northern Engineering Works crane of 10-tons capacity and is equipped with axle lathes, boring mills and 4 truck erecting pits, while four material tracks enter as shown in Fig. 9.

Two erecting shops, each 60 by 280 feet, connect with the just mentioned building and a well equipped wood shop, 20 by 280 feet, occupies the space between. Two hundred and eighty

1,800-H.-P. feed water heater. A 500-H.-P. Porter-Allen, tandem-compound engine, direct coupled to a Westinghouse A. C. generator, has been ordered.

A large number of stock cars have been repaired for the A., T. & S. F. and 300 new stock cars built for the C. & G. W., as well as 300 gondolas for the Midland Valley. Among other recent orders filled might also be mentioned three locomotives

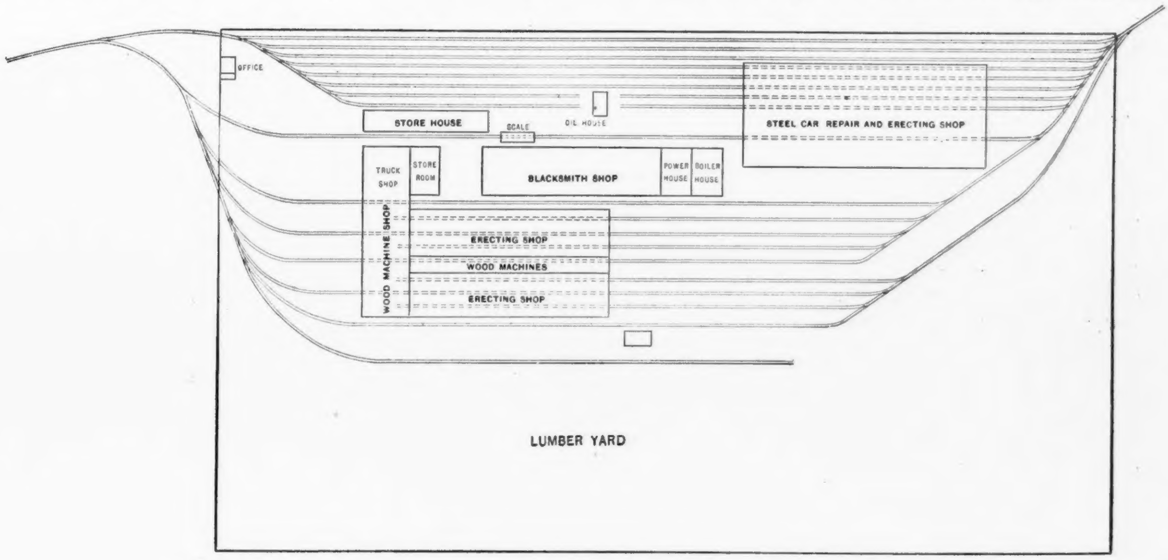



FIG. 9— GENERAL PLAN OF CAR DEPARTMENT (EAST WORKS) HICKS LOCOMOTIVE & CAR WORKS

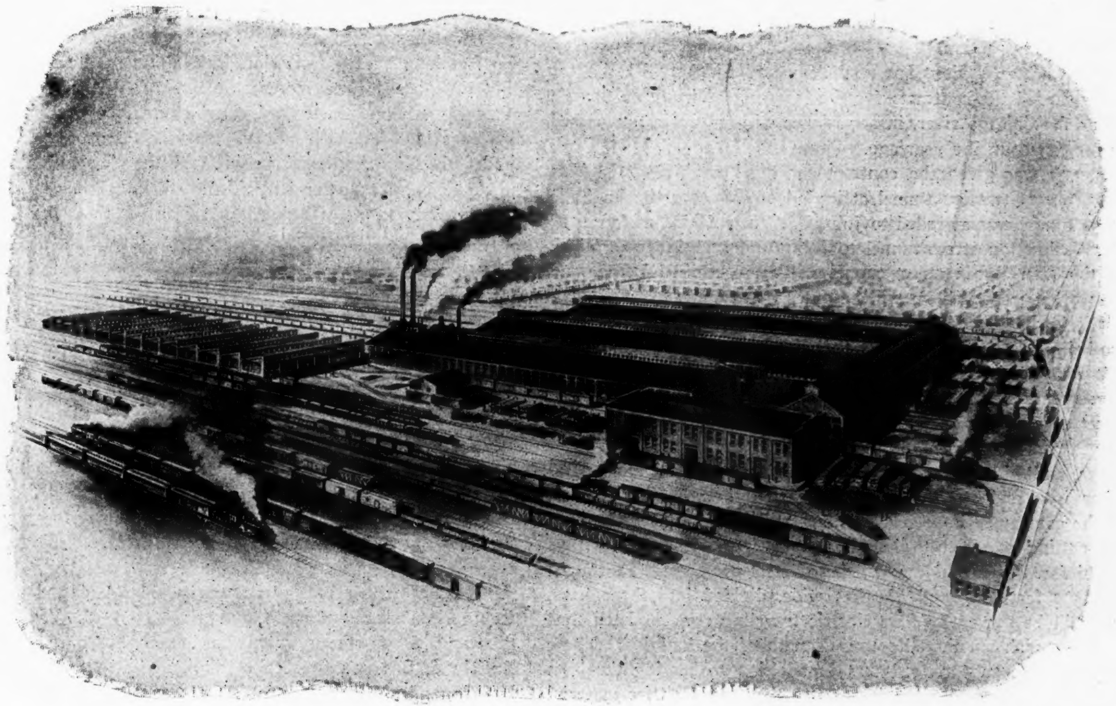


FIG. 10— GENERAL VIEW OF BUILDINGS INDICATED IN FIG. 9

feet of a 60 by 360 foot building constitutes the smith shop; the remaining portion being equally divided between a power and boiler house. The present power equipment consists of a 250-H.-P. Westinghouse vertical cross-compound engine, belt-driving a 180-K.-W. Westinghouse A. C. generator, a 12 by 12 inch Westinghouse air compressor, a 6 by 36 inch Cook pump and a Worthington duplex feed pump in connection with an

for Holly & Swink, two for the Georgetown & Western, one for the St. Louis, Rocky Mountain & Pacific, eight new coaches for the Bessemer & Lake Erie, six for the Atlanta, Birmingham & Atlantic, six express cars, two combination cars and two mail cars for the Atlantic Coast Line, one private car for the Long-Bell Lumber Co., one private car for the Kansas Fish Commission, and one for the Western Union Telegraph Co.

## *Miscellany*

"Standard Scales" is the title of a catalogue which has been issued by the Buda Foundry & Mfg. Co., Railway Exchange, Chicago. It treats of railroad track scales, stock scales, coal hopper scales, depot scales, wagon scales, and portable scales, and gives illustrations of the various parts of track scales as they appear separately, and when partially installed. Useful information is also given regarding scale foundations and other work in connection with the installation of railroad scales. The Buda Company has also issued a catalogue illustrating and describing the Bogue & Mills system of safety crossing gates, also giving a list of parts for repairs, together with prices for same.

The Union Portland Cement Company, Ogden, Utah, recently ordered two 1,200 K. W. Westinghouse-Parsons steam turbines for their plant at Portland, Utah. The turbine will operate on 175 pounds steam pressure, 27 inch vacuum, and no superheat; driving enclosed type turbo-generators delivering 480 volts at a frequency of 30 cycles to three-phase distribution system. The turbines will operate twenty-four hours per day, generating power for motor driven machinery throughout the mill and electric locomotives operating between the quarry and the mill. A 750 K. W. Westinghouse-Parsons turbine has been ordered for the Pittsburg Reduction Company's plant at East St. Louis, Ill. operating non-condensing on a steam pressure of 150 pounds. The California Fowder Works have added another turbine to their plant at Pinole, Cal. This machine runs parallel with a 400 K. W. Westinghouse-Parsons unit already installed at the plant, and through static transformers with 250 K. W. reciprocating engine units, with which the present 400 K. W. unit is now operating successfully. This turbine has made a remarkable record for itself. Starting on July 27, 1905, it has operated continuously for nearly a year with but one shut down for the purpose of inspection.

The Chicago Union Traction Company, Chicago, Ill., has at last awarded the contracts for the lowering of its three tunnels under the Chicago river, in accordance with an ordinance passed by the city council a year ago. The Great Lakes Dredge & Dock Company was given the contract for the lowering of the Van Buren street traction tunnel at its bid of $180,000; the La Salle street tunnel was awarded to John P. Agnew & Co., at $103,000; the Washington street tunnel to John Angus at $59,000. Work on the Van Buren street tunnel will be commenced first, and the work on all of them will be pushed as rapidly as possible.

The business facilities of Joseph T. Ryerson & Son, Chicago, are being greatly increased by the addition of a new building to that group of their warehouses extending from Fifteenth to Seventeenth street, and from Campbell avenue to Rockwell street covering two city blocks. An assorted stock of structural shapes will be carried in this building, as well as bars and plates, and will supplement the stock of tubes, sheets, rivets and other iron and steel commodities carried in other warehouses of the company. Fourteen machines will be installed to be used for cutting material to length and other small fabrication as called for. This building will be of steel construction throughout, 500 feet long and 385 feet wide, divided into three bays, and will be served by four electric traveling cranes of ten tons capacity, each running the entire length of the building. These travelers are so arranged that in addition to serving the bays in which they are located lengthwise they can transfer material to other bays, facilitating the handling of stock in all parts of the plant.

The Keystone Driller Company, Beaver Falls, Pa., manufacturers of a variety of machines covering the field of drilling work, have issued a series of catalogues describing the Keystone drills. The catalogue describes several sizes of portable traction and non-traction water well machines of capacities varying from 100 to 1,000 feet. A part of the catalogue is devoted to an illustrated discussion of the art and science of drilling wells. It contains, also, full instructions for setting up and operating the machines, dressing drilling tools, driving and withdrawing pipe, etc., etc. A second catalogue is devoted to mineral prospecting and placer testing machines. It contains a discussion of that class of work and instructions for prospecting dry or wet alluvials, swamps, old river beds, clay, sand, gravel or boulder deposits for gold, tin or other minerals. Also directions for exploring for coal, iron, zinc, lead or other ores, either in alluvials or solid rock. A third, Catalogue No. Two-B, illustrates and describes the percussion core drill outfit, which can be used in connection with any good churn drill. It will take out, in unbroken section, a core of any material except the very hardest rock, and is specially adapted for coal testing, making soundings for foundations and under-river tunnels, etc. Catalogue No. 3 is devoted to portable oil well rigs, various sizes, for extreme depths of from 1,000 to 2,500 feet. It contains an elaborate discussion of that kind of work and information compiled from experience in deep well drilling.

The Strangen-Wick Railway Company, which operates a suburban line near the city of Stockholm, the capital of Sweden, has contracted with the Westinghouse Electric & Mfg. Co., of Pittsburg, for the electrical equipment of the cars to operate this road, with the single-phase system. This recognition of the superiority of American electric railway apparatus is the result of an elaborate test instituted by the Swedish government about a year ago. In this test, manufacturers of electric railway systems from America and Europe entered into competition and the palm was finally awarded to the Westinghouse Company, which was then given an order for an alternating current single-phase locomotive. The order from the Strangen-Wick Company calls for the same type of electric railway motors.

Work is under way on the new plant of the Wabash road at Decatur, Ill., which will embrace several extensive buildings, two of which will be 586 feet long by 280 feet wide. Besides these immense structures there are two others, which are to be 480 feet long by 120 feet wide, in addition to the usual smaller shops incidental to a modern layout. The Wabash has forty acres at Decatur, thirty-two of which will be occupied by the buildings noted, which are to represent the best practice in modern railway shop construction, with the view to build as well as repair motive power and rolling stock.

According to press reports it is stated that the Canadian Pacific has practically decided to build a new steel bridge to span the Belly river at Lethbridge, Alberta. The purpose of the company in building it is to straighten the track and shorten the distance between Lethbridge and Maclod. The grade on the new proposed line will also be much easier, and heavy loads can be carried at very much less cost. The proposed new bridge is to be about one mile in length and 300 feet high, and it is thought that work on the masonry work will be commenced this season.

The Pittsburg Post in a recent issue states that five more important railroad systems will have passenger and freight terminals in Pittsburg in a short time, and names the newcomers as follows: Erie Railroad, main line from New York to Chicago; Buffalo, Rochester & Pittsburg, now entering by trackage rentals, but which will come on its own line and extending from Pittsburg to Buffalo and Rochester, N. Y.; Pittsburg Shawmut & Northern, main line from Pittsburg to Buffalo Buffalo & Susquehanna Railroad, main line from Pittsburg to Buffalo and through Central Pennsylvania oil field; Pittsburg, Binghamton & Eastern Railroad, now building from Binghamton westward to Dubois, and with main line to be extended from Pittsburg to Albany, N. Y., where direct connection will be made to Boston, Mass. All these roads will secure entrance to Pittsburg and a share of its vast traffic by joint ownership of a new four-track road less than fifty miles long, namely the Pittsburg & Northeastern, which has been chartered and surveyed from Hazelwood northeast to South Bend, Indiana county. The plans, it is stated, not only include extensive freight terminals, but the eventual construction of a passenger station to cost $3,000,000.